May 14, 2014

Mr. Ken Thiessen
Oregon Department of Environmental Quality
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Portland, OR 97201-4987

Subject: **Use of High Concentration Hot Spot Values for Ecological Risk Management in the Feasibility Study**
Willamette Cove Upland Facility
ECSI No. 2066

Dear Ken:

This document was prepared in support of the feasibility study (FS) for the Willamette Cove Upland Facility (the Facility). The FS is being performed as part of Voluntary Cleanup Agreement EC-NWR-00-26 (VCP Agreement) between the Port of Portland (Port), Metro, and the Oregon Department of Environmental Quality (DEQ). The Facility is defined in the DEQ Environmental Cleanup Site Information (ECSI) database as ECSI No. 2066.

As part of the FS process for the Facility, DEQ calculated high concentration hot spot values for the Facility, and directed the Port/Metro to screen individual sampling locations against the hot spot values. The hot spot values were prepared to support the FS, based on the Environmental Cleanup Rules [See OAR 340-122-090]. For ecological receptors, the high concentration hot spot values are based on concentrations that are ten-times the site-specific acceptable risk-based concentration (RBC), or ten-times appropriate screening levels if site-specific RBCs have not been calculated. In feasibility studies, Oregon's hot spot rule ultimately works to apply a preference for treatment or removal when weighing cleanup alternatives but does not mandate a particular result. Rather, the focus is on minimizing risk to human health or the environment if exposure occurs. ORS § 465.315(2)(b)(A); see also OAR 340-122-0115(32)(b). Hot spot values should be established based on available information to best represent exposure risks at the Facility and to reflect site-specific conditions.

The hot spot values that DEQ calculated for the Facility are shown in Table 1. DEQ calculated hot spots for a list of chemicals that included chemicals of concern (COCs) identified in the Ecological Risk Assessment (ERA), and for chemicals that were not COCs. Among the chemicals DEQ included were mercury, lead, and polychlorinated dibenzo dioxins and furans (D/Fs). The Port/Metro requests that, for these three chemicals, DEQ recalculate RBCs and high concentration hot spots values to more accurately reflect actual risks of exposure at the Facility by incorporating site-specific and regional information. Specifically, the following reasons support recalculation of RBC and hot spot values:

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- Mercury – The RBCs and hot spot values are below regional background concentrations, largely because they are based on environmental methyl mercury, whereas the predominant form of mercury at the Facility is likely inorganic mercury;

- Lead – The RBC was below background; and

- D/F – DEQ did not provide hot spot values and instead only used generic Toxicity Equivalence (TEQ) values without considering urban background levels.

Each chemical and reasons supporting recalculation are more thoroughly discussed below.

Mercury

The current mercury hot spot values for the Facility unnecessarily inflated and do not accurately reflect risk because: (1) methyl mercury-based toxicity factors and RBCs do not represent risk from total mercury, and (2) the regional background concentrations established by DEQ for the Portland Basin (DEQ 2013) are higher than the RBCs and hot spot values.

The DEQ RBC and hot spot values were based on methyl mercury, whereas the mercury data for the Facility is represented by total mercury concentrations. Total mercury analysis includes all forms of mercury including organically-transformed methyl mercury and inorganic forms. This distinction is important because methyl mercury is substantially more bioavailable than inorganic mercury; less than 1% of inorganic mercury is absorbed in vertebrate gastrointestinal tract, but >95% of methyl mercury is absorbed (ASTDR 1999, USEPA 2001). This difference in bioavailability makes environmental methyl mercury more toxic than inorganic mercury forms. After absorption, methyl mercury can be widely distributed through the vertebrate body. The biological half-life of methyl mercury is about 70 days, with most of the mercury elimination occurring in feces after demethylation in the liver (ASTDR 1999, 2013; USEPA 2001, Clarkson 2002). The primary toxic mechanism of methyl mercury and inorganic mercury is binding of the mercuric ion to sulfur atoms in certain amino acids, which disrupts protein structure and cellular function.

Although methyl mercury and inorganic mercury have the same or similar modes of toxic action, methyl mercury exposure via oral routes is generally more toxic because it is more readily absorbed in the intestine. As a result, RBCs for methyl mercury are substantially lower than for inorganic mercury. If the form of mercury present at the Facility is predominately inorganic, then applying the methyl mercury RBCs to total mercury can substantially overestimate health risk and the need for remediation.

Globally, the primary source of inorganic mercury in soils is the deposition from airborne sources, like burning of coal in power plants and incineration of medical waste (ATSDR 2013). Local contamination from mercury can be due to spills or other focused releases that result in elevated concentrations in relatively small areas. Focused releases of mercury predominately involve inorganic mercury. Although methyl mercury is a by-product of some industrial processes, such as chloralkali manufacturing (ATSDR 1999), there is no evidence of such industrial operations at or near the Facility. The wide range of marine and light industrial activities at the Facility are more consistent with sources of inorganic mercury.

While methyl mercury is the most bioavailable and potentially toxic form of environmental mercury, concentrations in upland soils and even wetland sediments tends to be less than 1%

of the total mercury present (Burns et al. 2014, Obrist 2011, Obrist 2012, Grigal 2003). Therefore, without an external source of methyl mercury to the Facility soils, application of a methyl mercury-based RBC and hot spot value does not seem to be warranted.

Further, DEQ's methyl mercury-based RBC (0.01 mg/kg) and hot spot value (0.1 mg/kg) are lower than the total mercury background concentration (0.23 mg/kg) established by DEQ for the Portland Basin (DEQ 2013). This difference highlights the potential importance of considering chemical form in setting RBCs and hot spot values. It also highlights the question of whether a hot spot value should be based on an RBC that is lower than background concentrations. An RBC that is lower than background highlights the lack of applicability of the underlying toxicity information to site conditions. Overestimate of bioavailability, poor toxicity information, differences in chemical form, and other factors make the RBC unrepresentative of risk conditions at a site. By extension, the corresponding hot spot value would also not be representative. At a minimum, in situations where this occurs, the Port/Metro suggests that neither the RBC nor hot spot value should be used as primary decision criteria for identifying remedial actions.

The Port/Metro recommends that the DEQ Level II Screening Level Value (SLV) of 0.3 mg/kg be used as the basis of the hot spot value, resulting in a value of 3 mg/kg. This value is still conservative because it is based on a RBC (plants) which is near the DEQ background value of 0.23 mg/kg, and is the lowest RBC that is higher than background.

Lead

The current hot spot value for lead does not accurately represent risk at the Facility because the RBC from which it was derived is lower than regional background concentrations. The RBC (33 mg/kg) selected by DEQ for calculating the hot spot value (330 mg/kg) was based on exposure parameters for the American robin, assuming an exclusively invertebrate diet. The RBC is consistent with the toxicity factors and exposure parameters that were directed by DEQ for use in the residual risk assessment (RRA; Formation 2014). However, as noted in the RRA, the risk estimate based on these toxicity factors and exposure parameters corresponds to unacceptable risk estimates (i.e., HQ>2) at background lead concentrations for the Portland Basin (DEQ 2013). As noted above for mercury, a RBC that is below the DEQ background concentration suggests that the underlying assumptions are not representative of site conditions, and should not be relied upon for cleanup decisions.

Although the common inorganic and organic forms of lead have a wide range of bioavailability (ATSDR 2007), we assume that the DEQ background value for the Portland Basin is based on data representing the common forms of lead in urban areas. This would include common mineral forms of lead such as lead oxides, as well as anthropogenic organic forms both of which could have higher bioavailability. Other mineral forms have low bioavailability, such as lead sulfides that are typically less than 20% available.

The toxicological information used to calculate the RBC is based on highly available (100%) forms of lead (lead acetate), and therefore likely overestimates potential uptake for many mineral forms of lead. However, the bioavailability of the lead forms represented in the background measurement is likely to be high. The background concentration is more than two times the RBC, indicating that the RBC is probably not representative of conditions at the Facility, and probably overestimates the need for cleanup.

The Port/Metro recommends that the hot spot value for lead be set at 1,200 mg/kg, as previously presented in the FS (Apex 2014). The value is based on the RBC for plants, which is the lowest RBC that is higher than background.

Dioxins/Furans

The RBC identified by DEQ, "≥10 TEQ", does not correspond to a concentration in soils. Instead, it appears to be based on the overall exposure to D/Fs normalized to 2,3,7,8 tetrachlorodibenzo dioxin (TCDD) using the World Health Organization's Toxicity Equivalence Factors (TEFs; Van den Berg et al. 2006). No corresponding soil RBCs or hot spot values were provided.

The Port/Metro estimated the RBC for mammals and birds based on site-specific exposure parameters used in the RRA for the short-tailed shrew and American robin. The resulting RBCs calculated for TCDD, were 1E-4 mg/kg for the robin and 3E-6 mg/kg for the shrew. The corresponding hot spot value of 3E-5 mg/kg was identified for the shrew since it has the lowest RBC. This hot spot value is based on the individual chemical, TCDD. With the appropriate TEF-based adjustments, the TCDD hot spot value can be used as a surrogate to calculate hot spot values for other D/F congeners. However, use of the TEFs to develop a hot spot value for summed TCDD-equivalents is not consistent with Oregon's hot spot rule. Hot spots are identified based on individual chemicals or congeners.

Oregon DEQ does not publish background concentrations for organic chemicals, but data on urban areas of the northwestern US are available from the Seattle area (Washington State Department of Ecology 2011). The average total TCDD-TEQ concentration from the Seattle data was 1.9E-5 mg/kg, which is approximately 6-times higher than the back-calculated RBC for mammals, and just ~30% below the DEQ hot spot value for mammals.

However, unlike metals, requiring cleanup for organic chemicals to below background concentrations will not reduce risk, because surrounding areas presumably have similar concentrations. Comparison of the D/F RBC and hot spot value to estimates of urban background is not analogous under Oregon rules to the comparison to natural background for metals, but it provides important perspective on how risk is, and should be represented. Therefore, use of RBCs that are below effective background concentrations, and corresponding hot spot values does not accurately represent conditions at the Facility. The Port/Metro recommends that the potential urban background be considered when setting the D/F cleanup goals for the Facility.

Please call me at (503) 415-6325 if you have any questions.

Sincerely,

Dwight Leisle
Environmental Program Manager

Attachments:

Table 1 – Risk Based Concentrations and High Concentration Hot Spot Values Provided by Oregon DEQ for Ecological Receptors

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Table 1. Risk Based Concentrations and High Concentration Hot Spot Values Provided by Oregon DEQ for Ecological Receptors.

Willamette Cove Acceptable Soil Concentrations and Hot Spot Concentrations					Willamette Cove Hot Spot Concentrations					
	Acceptable Risk LConcentrations (mg/kg)					Hot Spot Concentrations (mg/kg)				Lowest Hot Spot Concentration (mg/kg)
Contaminant of Concern	Plants	Invertebrates	Robin	Shrew	Contaminant of Concern	Plants	Invertebrates	Robin	Shrew	
Aluminum	50	600	2250	535	Aluminum	500	6000	22500	5350	500
Antimony	5	200	NA	2.7	Antimony	50	2000	NA	27	27
Barium	1	0.1	425		Barium	10	1	4250		1
Cadmium			5.1	6.5	Cadmium			51	65	51
Chromium	50	0.4	160		Chromium	500	4	1600		4
Copper	70	80	88	82	Copper	700	800	880	820	700
Iron	10	120			Iron	100	1200			100
Lead	120	1700	33	122	Lead	1200	17000	330	1220	330
Mercury	0.3	0.1	0.01	0.146	Mercury	3	1	0.1	1.5	0.1
Nickel	38				Nickel	380				380
Vanadium	2		16		Vanadium	20		160		20
Zinc	160	120	673	201	Zinc	1600	1200	6730	2010	1200
Bis(2-ethylhexyl)pthalate				4.6	Bis(2-ethylhexyl)pthalate				46	46
Butylbenzl phthalate				1.2	Butylbenzl phthalate				12	12
Dibutyl Phalate			2.25	0.75	Dibutyl Phalate			22.5	7.5	7.5
Dibenzofuran				0.01	Dibenzofuran				0.1	0.1
Total HPAH			NA	5.6	Total HPAH			NA	56	56
Diesel Range Hydrocarbons		200	6000	6000	Diesel Range Hydrocarbons		2000	60000	60000	2000
Total PCBs	40		0.7	0.1	Total PCBs	400		7	1	1
Dioxin TEQ			SUM Congener TQs <1	SUM Congener TQs <1	Dioxin TEQ			SUM Congener TQs ≥ 10	SUM Congener TQs ≥ 10	SUM Congener TQs ≥ 10
Notes										
Mammalian Mercury PRG based on Oak Ridge National Laboratory, 1997, PRGs for Ecological Endpoints										
Avian vanadium RBC calcuated using a LOAEL and EPA Eco SSL methodology										
Diesel Range organics wildlife value is the lower of the bird (robin) or mammal (shrew) from Washington DOE										